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Applicant: Werner, Rudi 2000 Hamburg, DE

Inventor: same as applicant

Rotary Piston Machine

Subject of the invention is a rotary piston machine with two cone gear wheels arranged in an obtuse angle to each other, both having at least two pyramid shaped teeth. During rotation of the gear wheel, their arched tops glide while sealing smoothly and alternately along one of their neighboring tooth flanks. The gear wheels are rotating along their axes in a ball shaped working area; with its ball shaped periphery having its center in the meeting point of the axes of the cone gear wheels and being adjacent to the cone gear wheels and the convex (away from axis) or concave (facing axis) areas of each tooth. The arrangement creates chambers of alternating sizes during the rotation of the cone gear wheels allowing substances to flow in and out through a respective inlet and outlet windows located in the chamber.

This machine can be used as a pump, compressor, power generator through substances being put under pressure (Fig. 22-24), as a four-cycle engine (Fig. 1-4) or as a two-cycle machine (Fig. 25-26), where it is possible to have different sizes (and ratios) of the intake/compression chambers and the working areas/exhaust.

3221994

Rudi W e r n e r
Laugsaengerweg. 2 d
2000 Hamburg 53

CLAIMS:

1. Rotary piston Machine, characterized in that
two conical gear wheels are arranged in an obtuse angle to each other, both having at least two pyramid shaped teeth. During the rotation of the gear wheel, their arched pinnacles glide smoothly while sealing and alternately along one of their neighboring tooth flanks. The gear wheels rotate along their axes in a ball shaped working area; with its ball shaped periphery having its center in the meeting point of the axes of the cone gear wheels and being adjacent to the cone gear wheels and the convex (away from axis) or concave (facing axis) areas of each tooth. The arrangement creates chambers of alternating sizes during the rotation of the cone gear wheels allowing substances to flow in and out through a respective inlet window and outlet window located in the chamber.

2. A rotary piston machine according to claim 1, characterized in that:
The axial delimitation of the working area is made by two conical gear wheels arranged in an obtuse angle to each other, with their tips being in the center of the ball shaped periphery and their basis being in the casing of the working area.
The either cone, axial or ball shaped radial delimitation of the working area is

in part or in total made by the bases of two rotors (9, 10) with each of the rotors being mounted in the housing (11) in a way that it can rotate in the axes of the axial delimitation, so that their axes which are meeting in the center of the working area are arranged in a obtuse angle to each other.

Both rotors (9, 10) – in the case of a ball shaped working area – have each at least two pyramid shaped teeth (1 –8) with their pinnacles touching each other at the meeting point of the rotors' axes.

Both rotors (9, 10) - in the case of a partially hollow sphere-shaped working area – have each at least two flat pyramid and/or wedge-shaped teeth (1 –8) featuring dome-shaped, concave top areas are arranged so that the pyramid or wedge-shaped pinnacles lie in a – and/or around a certain ball , found at the mid-point of the working area, the diameter of which is smaller than the ball at the mid-point of the delimited working area - and/or which lie tangential to this given ball, wherein the points of all the teeth (1-8) can be arranged in the same order– or not in the same order – as those of the other rotors, so that the most effective method is applied for each material that is to be transported, compressed, or expanded.

The parallel rotating surface of each tooth (1-8) glides smoothly while sealing or is adjacent to the cone-shaped axial working area boundary having a rotor mounted in a rotating position.

With machines featuring arched tooth surfaces (18) – the arched tooth surface (18) of each tooth (1-8) glides smoothly while sealing during one turn of the rotor along the parabolic tooth flank (14) - according to the angle of the rotor – and while passing the maximum working area being created (bottom dead center 20) and starting near the pinnacle head of the nearest tooth located on the opposite rotor

[Illeg.]

sliding along the parabolic tooth flank (14) of the neighboring tooth and permanently sealing and ending at its head. This movement is repeated with each rotation of the rotor and the sealing periods of both radial ends of the crest (18) of each tooth (1-8) slightly overlap according to the number of teeth and their relevant tooth width and thus create a permanent seal between the tooth surface (18) and the neighboring teeth flanks (14).

With machines featuring flat tooth surfaces (18) – the (in rotation direction) frontal, radial edge of the flat tooth surface (18) of each tooth (1-8) glides [illegible]. while passing the smallest working area being created (top dead center (19) along the parabolic tooth flank (14), starting near the basis of the neighboring tooth located on the opposite rotor and after a half rotation of the rotor, gliding smoothly while permanently sealing along said tooth pinnacle (18). After an additional half rotation it passes the bottom dead center (20) and returns to the initial position without touching any other flank. At the same time, the (in rotation direction) rear, radial edge of the flat tooth surface (18) of each tooth (1-8) glides

during a half rotation of the rotor along the parabolic tooth flank (14) and while passing the bottom dead center (20) starting near the pinnacle head of the nearest tooth located on the opposite rotor gliding smoothly while sealing along said tooth root and having passed the top dead center (19). After another half rotation it returns to the initial position without touching any other flank. The sealing periods of both radial ends of the crest (18) of each tooth (1-8) slightly overlap according to the number of teeth and their relevant tooth width and thus create a permanent seal between each of the tooth surfaces (18) and the neighboring teeth flanks (14).

In the direction of the rotor axes, the radial height of the teeth (1 - 8) with a flat crest (18) parallel to the rotation is at least double the radians on which the rotor axes lie out of alignment, such that the teeth (1 - 8), with rotationally parallel arched crests (18), are higher by double the crest radians;

The rotationally parallel arched crest (18), used for sealing, and/or the edges of the rotationally parallel flat crest (18) of each tooth (1 - 8) must be located opposite its own rotor hemisphere of the working area in each rotational angle position of the rotors (9, 10) and must not touch or pass the rotationally parallel symmetry plane of the working area if there is to be a permanent seal between the crests of the teeth (18) or their edges and one of the two flanks (14) of the neighboring teeth.

3. A rotary piston machine that works as a pump/compressor or as a power generator on substances under pressure according to claims 1 and 2, characterized in that:

Except for the two rotor surfaces in the working area, almost the entire boundary of the working area is in the form of an inlet (12) and outlet window (13) and is adjacent to the working area boundary that is in sealing contact with the teeth (1 - 8), only in the region of the top dead center (19) and bottom dead center (20), in such rotationally parallel radians that when the rotors (9, 10) are not turning, is there no exchange of substances between the inlet (12) and outlet window (13).

4. A rotary piston machine that functions as an expansion engine on substances under pressure according to claims 1-3, characterized in that:

The working area boundary of the housing (11), in sealing contact with the teeth (1 - 8), reduces the inlet window (12) from the top dead center (19) - opposite the direction of rotor rotation - in such radians that the

individual working chambers formed by the teeth (1 - 8) have passed the inlet window (12) before its volume is at the maximum and expands the substance in the working chamber until it reaches the outlet window (13), such that the magnitude of the expansion achievable in the working chambers depends on the radial length of the inlet window (12).

5. A rotary piston machine that functions as a compressor according to claims 1-3, characterized in that:

The working area boundary of the housing (11), in sealing contact with the teeth (1 - 8) *[illegible]* the outlet window from the bottom dead center (20) out in the direction of rotor rotation *[illegible]* reduces such radial lengths that in the *[illegible]* individual working chambers formed by the teeth (1 - 8), the compression of the substance to be compressed begins before they reach the outlet window (13), such that the magnitude of the compression generated in the working chambers, when they have reached the outlet window (13), depends on the radial length of the outlet window (13).

6. A rotary piston machine that works as an internal combustion engine according to claims 1 and 2, characterized in that:

The crest (18) of each tooth (1 - 8) is arched parallel to the rotation at least to the extent that the sealing contact line formed by the contact with one of the two tooth flanks (14) of the neighboring teeth remains closed in each rotational angle position of the rotors (9, 10).

Gas is only burned and expelled between the teeth resting on one rotor (9) (called working teeth 1, 3, 5 and 7), and is only taken in and compressed between the teeth resting on the other rotor (10) (called intake teeth 2, 4, 6 and 8);

The inlet window (12) is located only in the region of the intake teeth (2, 4, 6 and 8) - but out of reach of the flanks (14)

of the working teeth (1, 3, 5 and 7) and their contact line with the crests (18) formed by the seal during the intake of the fresh gases;

While the rotor is turning, the smallest working chambers formed between the individual intake teeth (2, 4, 6 and 8) reach the inlet window (12) within the working area boundary while their centers pass the top dead center (19) and - to achieve the greatest possible fresh gas filling level - have passed it shortly after their centers pass the bottom dead center (20), whereby their greatest achieved volume decreases again;

The outlet window is located only in the region of the working teeth (1, 3, 5 and 7) - but out of reach of the flanks (14) of the intake teeth (2, 4, 6 and 8) and their contact line with the crests (18) formed by the seal during the expulsion of the residual exhaust gases;

While the rotor is turning, the largest individual working chambers formed between the working teeth (1, 3, 5 and 7) reach the outlet window (13) just before their volumes are the greatest, so that the burned gas has expanded in them when their centers reach the bottom dead center (20), and have passed the outlet window (13) when their centers have passed the top dead center (19);

In the top dead center (19), in the region of the working chambers with the compressed fresh gases, an ignition device (16) is placed, which is controlled periodically - or, in the form of a continuous burner/igniter whose opening to the working area boundary is periodically covered by the teeth (1 - 8), is overridden by the teeth (1 - 8) themselves;

When the rotor reverses its direction of rotation, the inlet window (12) serves as an outlet window, and the outlet window (13) as an inlet window, such that gas is burned and expelled between the intake teeth (2, 4, 6 and 8) - and gas is taken in and compressed between the working teeth (1, 3, 5 and 7).

7. A rotary piston machine that functions as an internal combustion engine according to claims 1 and 2, characterized in that:

The crest (18) of each tooth (1 - 8) is flat, parallel to the rotation;

Gas is only burned and expelled between the teeth (called working teeth 1, 3, 5 and 7) of one rotor (9), and is only taken in and compressed between the teeth (called intake teeth 2, 4, 6 and 8) of the other rotor (10);

The inlet window lies only in the region of the intake teeth (2, 4, 6 and 8) - but out of reach of the flanks (14) of the working teeth (1, 3, 5 and 7) and their crests (18);

While the rotor is turning, the smallest working chambers formed between the individual intake teeth (2, 4, 6 and 8) reach the inlet window (12) within the working area boundary while their centers pass the top dead center (19) and - to achieve the greatest possible fresh gas filling level - have passed it shortly after their centers pass the bottom dead center (20), whereby their greatest achieved volume decreases again;

The outlet window (13) lies only in the region of the working teeth (1, 3, 5 and 7) - but out of reach of the flanks (14) of the intake teeth (2, 4, 6 and 8) and their crests (18);

While the rotor is turning, the largest individual working chambers formed between the working teeth (1, 3, 5 and 7) reach the outlet window (13) shortly before its volume is at its greatest; so that the burned gas has expanded inside them when their centers reach the bottom dead center (20);

The individual working chambers formed between the working teeth (1, 3, 5 and 7) have passed the outlet window (13) when their front boundary passes the top dead center (19);

In the direction of the rotor axes, the radial height of the working teeth (1, 3, 5 and 7) is greater than that of the intake teeth (2, 4, 6 and 8), so that a gap remains in the top dead center (19) between the axial working room boundary, in whose axis the rotor (10)

of the intake teeth (2, 4, 6 and 8) is not mounted and the crest (18) of the intake tooth (2, 4, 6 and 8) located there at that time;

At the root of each tooth (1 - 8), an overflow trough (15) is formed in the front flank (14) in the direction of rotor rotation;

In each front tooth flank (14), the radial edge of the overflow trough (15) passes from the rear radial crest edge (18) of the tooth (1 - 8) - and the overflow trough (15) thus becomes usable when the front crest edge (18) of the same tooth passes the top dead center (19), so that precompressed fresh gas flows between the intake teeth (2, 4, 6 and 8) through the overflow trough (15) of each working tooth (1, 3, 5 and 7) also to the top dead center (15) between the axial working area boundary and crest (18) of the intake tooth (2, 4, 6 and 8) found there - and the rest of the precompressed fresh gas, which is still between the axial working area boundary and the crest (18) of the working tooth (1, 3, 5 and 7) that is located just before the top dead center at that time flows through the overflow trough (15) of each intake tooth (2, 4, 6 and 8) into the rear - in the direction of rotation - working chamber, where it flushes out burned gas that has not been expelled without leaving any residual gas;

In the top dead center (19), in the region of the working chambers with the compressed fresh gases, an ignition device (16) is placed, which is either controlled periodically - or is a continuous burner/igniter whose opening to the working area boundary is periodically covered by the teeth (1 - 8), and is overridden by the teeth (1 - 8) themselves;

8. A rotary piston machine according to claims 1 - 7, characterized in that:

The intake - compression ratio is determined by the angle at which the two axial, spherical working area boundaries - and thus the axes of the rotors (9, 10)

stand in relation to one another and/or;

The intake - compression ratio is raised (lowered) by decreasing (increasing) the number of teeth (1 - 8) and/or;

The intake - compression ratio is lowered (raised) by enlarging (shrinking) the radius of both edges of the rotationally parallel flat crest (18) of each tooth (1 - 8) - according to claims 1 - 5 and 7 - and thus also the size of the parabolic indentation of the tooth flanks (14) or - according to claims 1 - 6 - the rotationally parallel arching of the crest (18) of each tooth (1 - 8) is enlarged (reduced) accordingly and/or;

According to claims 1 and 7 in internal combustion engines with rotationally parallel flat crests (18) of the teeth (1 - 8), the intake - compression ratio is lowered (raised) as the radial height - in the direction of the rotor axis - of each working tooth (1, 3, 5 and 7), so that the area in the top dead center (10) between the axial working area boundary and the crest (18) of the intake tooth (2, 4, 6 and 8) located there at the time is enlarged (reduced) and/or a depression is incorporated into the crest (18), according to the desired fresh gas compression.

9. A rotary piston machine according to claims 1 - 8, characterized in that:

Rotationally parallel the radial width of the teeth (1 - 8) of each rotor (9, 10) - and thus the size of the individual working chambers - can be different;

Rotationally parallel the radial width of each tooth (1, 3, 5 and 7) of one rotor (9) is the same - but different from that of all teeth (2, 4, 6 and 8) of the other rotor (10),

so that in internal combustion engines - according to claims 6 and 7 - the ratio of the intake/compression chambers to the combustion/exhaust chambers can be set to any size desired.

10. A rotary piston machine according to claims 1 - 9, characterized in that:

Except in claim 6 - a hollow sphere disc-shaped rotor (9) forms, entirely or partially and completed by the housing, the off-axis hollow, spherical casing of all working chambers and/or;

A spherical rotor (10) forms, entirely or as a partial sphere completed by the housing (11), the par-axis spherical boundary of the working area and/or;

Except in claim 6 - two hollow spherical disc-shaped rotors (9, 10) arranged axially in an obtuse angle to one another form, together with the housing (11), the off-axis hollow spherical casing of all working chambers and/or;

Two spherical segment-shaped rotors (9, 10), arranged axially in an obtuse angle to one another, form, together with the housing (11) the par-axis, spherical boundary of the working area and/or;

One of the two rotors (9, 10) forms, partially or entirely, one of the two axial boundaries of the working area, so that - in the case of "and" - and between section 3 and 4 - on both rotors positioned in the same axis, the same teeth are attached.

11. A rotary piston machine according to claims 1 and 6 - 10, characterized in that:

The ignition device (16) is periodically controlled - or its opening, which is periodically covered by the teeth (1 - 8), is overridden by the teeth themselves, whereby the ignition device (16) regulates a constant injection device, whose injection pressure regulates the rotors (9, 10) or can be a constant burner/igniter.

12. A rotary piston machine according to claims 1 - 11, characterized in that:

In machines with arched tooth tips (18), the curvature of the rotationally parallel arching of the tooth tips (18) may be even or uneven, symmetrical or asymmetrical, strongly or weakly - but at no point weaker than the curvature of the point opposite the specific point on the rotationally parallel circle if a closed sliding sealing line between crests (18) and flanks (14) of the teeth (1 - 8) should remain intact;

The arching of the crests (18) of all teeth (1 - 8) can be the same or different from tooth to tooth - but also from rotor to rotor.

13. A rotary piston machine according to claims 1 - 12, characterized in that:

In machines with flat and/or arched tooth surfaces, the rotationally parallel flat and/or arched tooth surfaces (18) of the teeth (1 - 8) and, as a result of this, the flanks (14) of their neighboring teeth in the radial direction can be straight or curved, whereby this curvature can be even or uneven, symmetrical or asymmetrical - and can also change - and can thus also be wavy and/or serrated and/or grooved;

The radial curvature of the tooth surfaces (18) of all teeth (1 - 8) and, as a result of this, the flanks (14) of their neighboring teeth can be the same or different from tooth to tooth - but also from rotor to rotor.

14. A rotary piston machine according to claims 1 - 13, characterized in that:

In machines with a working area in the form of a partial hollow sphere in which the inlet window (12) is also or is only formed in the center-near working area boundary of the housing (11) - the radial incline of the teeth (1 - 8) according to claim 2, section 4 - is for one thing used advantageously in the known art for internal combustion engines, such that the center-near end of a tooth flank (14)

of one working chamber reaches the center-near inlet window (12) in the top dead center (19), while the center-far end of the flank (14) of the neighboring tooth of the same working chamber the outlet window (13) has not yet entirely passed, whereby the residual exhaust gas is flushed out through the outlet window (13) by the fresh gas that is already flowing in, by means of centrifugal force and mass inertia - the effect of which furthermore can also be used advantageously for compressors or power generators with the substances under pressure from the helical gearing which exit the outlet window (13).

Guide vanes (21) are placed in the inlet (12) and outlet windows (13) and/or the inlet (12) and outlet window (13) itself is designed similarly to be favorable to flow.

15. A rotary piston machine according to claims 1 - 6 and 8 - 12, characterized in that:

Both rotors (9, 10) can rotate in both directions, whereby the inlet window (12) serves as the outlet window and the outlet window (13) as the inlet window when the rotors change direction.

16. A rotary piston machine according to claims 1 - 15, characterized in that:

The rotors (9, 10) are provided with a cone gear wheel (17), whose teeth intermesh, outside the working area, or the rotors (9, 10) are coupled by a synchromesh gear outside the working area, so that both rotors (9, 10) run synchronously even under extreme demands.

17. A rotary piston machine, which works as an internal combustion engine according to claims 1, 2, 9 - 13 and 16, characterized in that:

Gas is taken in, compressed, burned and expelled between the teeth (1 - 8) of both rotors (9, 10);

The inlet (12) and outlet window (13) is located in the region

of the teeth (1 - 8) of both rotors (9, 10), whereby the inlet window (12) is designed closer to the center than the outlet window (13) within the working area boundary of the housing, so that, while the rotors are turning, due to centrifugal force, an underpressure is exerted on the inlet window (12) and an overpressure is exerted on the outlet window and gas flows from the inlet window (12) to the outlet window (13) only;

The inlet window (12) and outlet window (13) are located in the area of the rotational angle, in which between the teeth (1 - 8) the largest individual working chambers, while the rotor is turning, reach the outlet window (13) somewhat earlier than the inlet window (12), so that *[illegible]* reach the inlet window (12), which *[illegible]* have *[illegible]* the burned gases.

The individual working chambers, while the rotor is turning, have passed the outlet window (13) somewhat earlier than the inlet window (12), so that the fresh gas that flows in after the chambers have passed the outlet window (13) builds up, thus achieving a better filling level of fresh gas;

In the top dead center (19), an ignition device (16) is placed, which is controlled periodically - or as a continuous burner/igniter or continuous injector, whose opening to the working area boundary is periodically covered by the teeth (1 - 8), and is overridden by the teeth (1 - 8) themselves, whereby, in the case of a continuous injection device, the number of rotations of the rotor (9, 10) regulates the level of the injection pressure;

The duration of the flushing out of the residual gas and flushing in of the fresh gas and the size of the different compression to working chamber ratios is determined by the rotational angle area before the bottom dead center (20) in which the individual working chambers, loaded with the ignited and expanding gases, reaches the outlet window (13), and the rotational angle area after the bottom dead center (20)

in which the shrinking individual working chambers have passed the inlet window (12);

In addition to the centrifugal force, the mass inertia of the gas is also used, in which the teeth (1 - 9) - according to claim 2, section 4 - are designed at a radial bevel and guide vanes (21) are arranged in the inlet (12) and outlet window (13) and/or the inlet (12) and outlet windows (13) themselves are designed similarly favorable to flow.

Rudi W e r n e r
Laugsaengerweg. 2 d
2000 Hamburg 53

ROTARY PISTON MACHINE

Subject of the invention is a rotary piston machine with two cone gear wheels arranged in an obtuse angle to each other, both having at least two pyramid shaped teeth. During rotation of the gear wheel, their arched tops glide while sealing smoothly and alternately along one of their neighboring tooth flanks. The gear wheels are rotating along their axes in a ball shaped working area; with its ball shaped periphery having its center in the meeting point of the axes of the cone gear wheels and being adjacent to the cone gear wheels and the convex (away from axis) or concave (facing axis) areas of each tooth. The arrangement creates chambers of alternating sizes during the rotation of the cone gear wheels allowing substances to flow in and out through a respective inlet window and outlet window located in the chamber.

An advantage of the invention is that there are only two moving parts in this engine. These two parts rotate only around their own axes, which can be mounted in the housing in a solid construction without difficulty.

The design of this engine is explained in more detail using the drawings. The following numbers are used in the drawing to refer to the parts listed below:

1 - 8 = teeth

9, 10 = rotors

11 = housing

12 = inlet window

13 = outlet window

14 = tooth flank

15 = overflow trough

16 = ignition device

17 = cone gear wheel

18 = tooth crest

19 = top dead center

20 = bottom dead center

21 = guide vanes

The following is shown: Figure 1 a section according to lines E - F in Figure 2 and J - K, L - N in Figure 3. The internal combustion engine shown in these figures has eight teeth 1 - 8 with arched crests 18. The intake teeth 2, 4, 6 and 8 are attached to rotor 10 and the working teeth 1, 3, 5 and 7 to rotor 9. The arrangement of truncated pyramidal teeth, whose center-near, concave crests are fitted to a ball, which is arranged at the center of the interior chamber and formed by the housing 11, is advantageous to the intake and exhaust of gases. Additional inlet and outlet windows can be placed inside this ball formed by the housing 11, whereby it is particularly advantageous for the inlet window 12 to be designed only in the center-near working area boundary of the housing 11, and the outlet window 13 only in the center-far working area, to achieve better intake of the fresh gases, and better exhaust of the residual exhaust gases, with the help of centrifugal force.

Fig. 2 A section according to lines A - B in Figure 1 and G - H in Figure 3. This figure shows the inlet window 12 in the ball around the center of the working area formed by the housing 11.

Fig. 3 A developed view of the diameter D in Figure 1, viewed from the center point M out. The front flank 14, in the direction of rotation, of the tooth 4 - and the rear flank of the tooth 5 - pass the top dead center 19. The front flank 14, in the direction of rotation, of the tooth 8 - and the rear flank of the tooth 1 - pass the bottom dead center 20. Ignited gases expand in both working chambers that are formed by the housing 11 and the teeth 5, 6 and 7 and 7, 8 and 1. The teeth 6, 7 and 8 take in fresh gas in from the inlet window 12. Fresh intake gas is compressed in the two working chambers formed by the housing 11 and the teeth 8, 1 and 2 and 2, 3 and 4. The teeth 1, 2 and 3 expel residual exhaust gas through the outlet window 13.

Fig. 4 A developed view of the diameter D in Figure 1, viewed from the center point M out, after a 22.5° rotation. The center of the tooth 4 has reached the top dead center 19 and the center of the tooth 8 has reached the bottom dead center 20. The two working chambers formed by the teeth 4, 5 and 6 and 6, 7 and 8 take in fresh gas from the inlet window 12. In the working chambers formed by the teeth 5, 6, and 7, the ignited gas expands. Burned gases are expelled from the working chamber formed by the teeth 7, 8 and 1 through the outlet window 13. Fresh intake gas is compressed in the working chamber formed by the teeth 8, 1 and 2 and the housing 11. Residual exhaust gas is expelled from the working chamber formed by the teeth 1, 2 and 3 through the outlet window 13.

Fig. 5 A developed view of the diameter D in Figure 1 after a 45° rotation, viewed from the center point M out. The front flank 14, in the direction of rotation, of the tooth 3 and the rear of the tooth 4 pass the top dead center 19, and those of the teeth 7 and 8 pass the bottom dead center 20. The ignition device 16 ignites the compressed fresh gas in the working chamber formed by the teeth 3 and 4 and the housing 11. The ignition device 16, which can also be an injection device for self-igniting fuels, can be periodically controlled - or as a continuous igniter/injector overridden by the teeth themselves. In the two working chambers formed by the teeth 4, 5 and 6 or 6, 7 and 8, fresh gas flows out of the inlet window 12. Ignited gas expands in the working chamber formed by the housing 11 and the teeth 5, 6 and 7. Residual exhaust gas that remains in the working chamber formed by the teeth 7, 8 and 1 and 1, 2 and 3 is expelled through the outlet window 13.

Fig. 6 A developed view of the diameter D in Figure 1 after a 67.5° rotation, viewed from the center point M out. The center of the tooth 3 has reached the top dead center 19 and that of the tooth 7 has reached the bottom dead center 20. Ignited gases expand in the two working chambers formed by the housing 11 and teeth 3, 4 and 5 and 5, 6 and 7. Fresh gas flows from the inlet window 12 into the working chambers formed by the teeth 4, 5 and 6 and 6, 7 and 8. The teeth 7, 8 and 1 and 1, 2 and 3 expel the residual exhaust gas through the outlet window 13.

Fig. 7 A partial developed view of an embodiment, in which, in an internal combustion engine, the radial (in the direction of rotation) width of the intake teeth 2, 4, 6 and 8 is greater than that of the working teeth 1, 3, 5 and 7, so that the

working/exhaust chambers are larger than the intake/compression chambers.

Fig. 8 An embodiment in which a partial developed view of an internal combustion engine is illustrated. In this embodiment, the rotationally parallel arching of the crest 18 of all teeth 1 - 8 is not even. The center of the crest is less arched than its edges. The advantage of this is that the height of the teeth 1 - 8 is lower and thus creates a smaller area at the top dead center 19 with the same travel of the teeth, whereby less clearance volume is achieved in compressors/power generators - or higher fresh gas compression in internal combustion engines. However, in order to obtain a closed sliding sealing line between crests 18 and flanks 14 of the teeth 1 - 8, the crest arching must not go below a minimum curvature. The rotors 9, 10 of the internal combustion engines shown in Figures 1 - 8 can rotate in both directions. If the rotors 9, 10 rotate against the direction shown, the inlet window 12 becomes an outlet window and the outlet window 13 becomes an inlet window, such that gas is then burned and expelled between the intake teeth 2, 4, 6 and 8 and taken in and compressed between the working teeth 1, 3, 5 and 7.

Fig. 9 A section according to the lines E - F in Figure 10 and J - K, L - N in Figure 12. The minimum height, which the teeth 1 - 8 must have in order for their tops to be able to slide with continuous sealing along the tooth flanks 14 of the neighboring teeth is shown in Figures 9 - 19. There, the crests 18 have no arching so that only their edges, whose sealing periods overlap in the top 19 and bottom dead centers 20, slide, creating a seal, on the flanks 14 of the neighboring teeth - and in the top dead center 19 only their rotationally parallel surfaces briefly slide, creating a seal, along the axial, conical working area boundary, in whose axis its rotor is not placed.

Fig. 10 A section according to the lines A - B in Figure *[illegible]* and G - H in Figure 12. The internal combustion engine shown has eight teeth 1 - 8. The intake teeth 2, 4, 6 and 8 are attached to the rotor 10 and the working teeth 1, 3, 5 and 7 are attached to the rotor 9. It can be *[illegible]* difficult to end the pyramidal tips of the teeth 1 - 8 at the center point M. In such a case, the teeth can be designed in a truncated pyramidal shape and their concave crests adapted to fit a sphere formed by the rotor 10 and arranged in the center of the working area.

Fig. 11 A developed view of the diameter D in Figure 9, viewed 22.5° before the illustrated rotor position of the center point M. The front (in the direction of rotation) flank 14 of the tooth 4, and the rear flank of the tooth 5, pass the top dead center 19. The front (in the direction of rotation) flank of the tooth 8, and the rear flank of the tooth 1, pass the bottom dead center 20. At the edge of the overflow trough 15 of the tooth 3, the rear (in the direction of rotation), radial crest edge 18 of the tooth 4 still prevents, the compressed fresh gas, which is further compressed in the working chamber formed by the housing 11 and the teeth 3, 4 and 5, from overflowing. The overflow trough 15 is designed in every front (in the direction of rotation) flank 14 at the tooth base of each tooth 1 - 8. Ignited gases expand in the two working chambers formed by the housing 11 and the teeth 5, 6 and 7 and 7, 8 and 1. The teeth 6, 7 and 8 take in fresh gas from the inlet window 12. Fresh intake gas is compressed in the two working chambers formed by the housing 11 and the teeth 8, 1 and 2 and 2, 3 and 4. The teeth 1, 2 and 3 expel residual combustion gas through the outlet window 13.

Fig. 12 A developed view of the diameter D in Figure 9, viewed from the center point M out. The center of tooth 4 has reached the top dead center 19 and that of tooth 5 has reached the bottom dead center 20. The precompressed fresh gas flows from the working chamber formed by teeth 2, 3 and 4 and the housing 11, through the overflow trough 15 of tooth 3, now opened by the crest edge 18 of tooth 4, into the working chamber formed by the housing 11 and teeth 3, 4 and 5. Since the center of these two working chambers is still before the top dead center 19, the fresh gas in the two working chambers is compressed further. Fresh gas is taken in from the inlet window into the two working chambers formed by teeth 4, 5 and 6 and 6, 7 and 8. Ignited gas expands in the working chamber formed by teeth 5, 6 and 7. Burned gasses are expelled from the working chamber formed by teeth 7, 8 and 1, through the outlet window 13. Fresh intake gas is compressed in the working chamber formed by teeth 8, 1 and 2 and the housing 11. Residual exhaust gas is expelled from the working chamber formed by teeth 1, 2 and 3 out of the outlet window 13.

Fig. 13 A developed view of the diameter D in Figure 15, viewed from the center point M out. The front (in the direction of rotation) flank 14 of tooth 3 and the rear flank of tooth 4 have reached the top dead center 19, and those of teeth 6 and 8 have reached the bottom dead center 20. The ignition device 16 ignites the compressed fresh gas in the working chamber formed by teeth 3, 4 and 5 and the housing 11. In this internal combustion engine as well, the ignition device 16 can be periodically controlled, or in the form of a continuous igniter/injector, overridden by the teeth themselves. In the two working chambers formed by teeth 4, 5 and 6 and 6, 7 and 8, fresh gas flows

through the inlet window 12. Ignited gas expands in the working chamber formed by the housing 11 and teeth 5, 6 and 7. Residual exhaust gas is expelled out of the two working chambers formed by teeth 7, 8 and 1 and 1, 2 and 3. Fresh gas is compressed in the working chamber formed by the housing 11 and teeth 8, 1 and 2. In the working chambers formed by the housing 11 and the crest 18 of tooth 3 and the overflow trough 15 of tooth 2, a small residual amount of compressed fresh gas, which has not been transferred, remains after the edge of the crest 18 of tooth 3 has passed the overflow trough of tooth 2, and flushes the residual exhaust gas that has not been expelled from the working chamber formed by teeth 1, 2 and 3.

Fig. 14 A developed view of the diameter D in Figure 15 after a further rotor rotation of 22.5°, viewed from the center point M out. The center of tooth 3 has reached the top dead center 19 and that or tooth 7 has reached the bottom dead center 20. Ignited gases expand in the two working chambers formed by the housing 11 and teeth 3, 4 and 5 and 5, 6 and 7. Fresh gas flows through the inlet window 12 into the working chambers formed by teeth 4, 5 and 6 and 6, 7 and 8. Teeth 7, 8 and 1 expel residual exhaust gas through the outlet window 13. Residual gas is also expelled from the working chamber formed by teeth 1, 2 and 3 and flushed out by the remaining fresh gas, which now flows out of the working chamber formed by the housing 11 and the crest 18 of tooth 3 and the overflow trough 15 of tooth 2, through the overflow trough 15 of tooth 2.

Fig. 15 A section according to the lines E – F in Figure 6 and J - K and L - N in Figure 13.

Fig. 16 A section according to lines A - B in Figure 15 and G - H in Figure 13. This internal combustion engine shown in Figures 15 and 16 show an embodiment in which the two spherical segment-shaped rotors 9 and 10, together with the interior of the housing 11, form a sphere around the center of the working area. In order to synchronize both rotors 9 and 10, even under extreme demands, and to prevent a possible pressing of the crest edges 18 onto the sealing flanks 14 of teeth 1 - 8, it is possible to attach a cone gear wheel 17, as shown in these figures, to each of the two rotors 9 and 10, whose teeth intermesh, such that both rotors can also be coupled with a synchromesh gear, even outside the working area, if necessary.

Fig. 17 A section according to the lines E - F in Figure 18 and J - K and L - N in Figure 19.

Fig. 18 A section according to the Lines A - B in Figure 17 and G - H in Figure 19. In figures 17 and 18, which show an embodiment in which the hollow spherical segment shaped rotor 9, to which the working teeth 1, 3, 5 and 7 , with their convex, off-axis surfaces, are attached, forms the external casing of all working chambers with its inner sphere surface. The center-near boundary of the working chambers forms the spherical rotor 10, to which the intake teeth 2, 4, 6 and 8 are attached with their center-near, concave surfaces.

Fig. 19 A developed view of the diameter D in Figure 17, viewed from the center point M. In Figures 17 - 19, the rotationally parallel radial width of the working

teeth 1, 3, 5 and 7 only half as large as those of the intake teeth 2, 4, 6 and 8, so that in this machine, the ratio of the intake/compression chambers to that of the working/exhaust chambers *[illegible]* ratio can also be formed in this embodiment in any size by different radial tooth widths.

Fig. 20 and 21 like the intake compression *[illegible]* also through the size of the radius R, can be formed *[illegible]* 18, 18'. The flanks of teeth 3, 3', 4 and 4' in Figure 20 are located at the top dead center 19 and those of teeth 7, 7', 8 and 8' in Figure 21 are at the bottom dead center 20. To the same degree that the radius R increases or decreases the size of the crest edges 18, the radial (in the direction of the rotor axles) height of all teeth 1 - 8 must also be increased or decreased.

Fig. 22 A section according to the lines E - F in Figure 23 and J - K and L - N in Figure 24.

Fig. 23 A section according to the lines A - B in Figure 22 and G - H in Figure 24.

Fig. 24 A developed view of the diameter D in Figure 22, viewed from the center point out. Figures 22 -24 show a compressor (pump) or power generator. The substance to be compressed, transported or expanded by the working *[illegible]* in the interior of the housing 11 through the inlet window into the enlarging individual working chambers, whereby, through the beveling of the teeth 1 - 8, the mass inertia of the substance is fully used, also with the help of centrifugal force, from the shrinking working chambers from the outlet window 13. This beveling of the teeth 1 - 8 is also

[illegible] shown in figures 1 - 14 *[illegible]* advantageous for the transfer of the gases. It is especially advantageous to place guide vanes 21 in the inlet window 12 and outlet window 13 and/or to design the inlet window 12 and outlet window 13 *[illegible]* favorable.

Fig. 25 A section according to the lines G - *[illegible]* in Figure 26/

Fig. 26 A section according to the lines A - B in Figure 25. This internal combustion engine shown in Figures 25 and 26 functions according to the two-cycle principle. Gas is sucked into the gaps of all teeth 1 - 8, compressed, burned and flushed out. Since the teeth 1 - 8 are radially beveled in shape, the inlet window 12 formed in the near-center, and the outlet window 13 formed in the far-center working area boundary of the housing 11, *[illegible]* in this machine *[illegible]* is especially advantageous in how the centrifugal force and the mass inertia of the gas are fully used, in that the guide vanes 21 and the flow-favorable shape of the inlet window 12 and outlet window 13 supports the exchange of gases. The individual working chambers loaded with the burned gases reach the outlet window first, so that *[illegible]* reach the inlet window 12, which has expanded. While they pass the inlet 12 and outlet window 13, the residual exhaust flows out of the outlet window 13 and is replaced by fresh gas that is sucked in from the inlet window 12, whereby the fresh gas that is still flowing in builds up in them and they fill *[illegible]* fill with fresh gas. The duration of the gas exchange depends on the radial length of the inlet 12 and outlet window 13. In this machine as well, the compression and working chamber ratio can be set to any

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size. It thus depends on the rotational angle range before the bottom dead center 20 of the working chambers in which the working chambers reach the outlet window 13 and the rotational angle range after the bottom dead center 20 in which they pass under the inlet window 12. The [illegible] direction 16 can [illegible] periodically controlled in this [illegible] - or in the form of a continuous igniter/*[illegible]* or continuous injector *[illegible]* by the teeth.

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